VARNA - BULGARIA

It is a pleasure to be here in Varna to discuss CHILDREN IN AN INFORMATION AGE: TOMORROW'S PROBLEMS TODAY. It is a joy to see this delegation, composed of 50 or so nationalities, gathered for this discussion and I hope that I can visit with each of you during this week.

I understand that these meetings will be mostly related to the use of computing machines in the home and in elementary education. These subjects are of course APROPO considering the importance of computing in the modern world; nevertheless, I would suggest that we all look at the subject itself, as the epitome of what every nation should desire for its children. In spite of my own great interest in computing, I urge that each delegate search his agenda for all items which fulfill the spirit of this title.

In a certain way, my addressing you is a kind of anomaly, and several people have suggested that I preface my remarks on computing with a suggestion as to how I got here. My name should give you a clue. My paternal grandparents lived at Boyadjik, in Yambol province, not too far from here. About Xmas, they had their first child, a boy, but Bulgaria was not then a peaceful place to rear a family. In the spring, the villagers were asked to go away, since the Turkish captors wished to burn the village. My grandfather, with the child who became my father in his arms, was running away, followed by his wife with foodstuffs, when they were followed by three soldiers on horseback, one of whom fired on my grandfather. The bullet creased my father's head and left a lifetime scar, but the same bullet killed my grandfather. Some people were killed then, but I have the opinion that my grandfather was singled out as a supreme patriot.

When my grandmother seized her baby, her husband breathed his last. My grandmother ran away; out of control, she found a winery and climbed a ladder beside an empty cask and dropped inside with her child. She and her son were near death when she was rescued by a woman looking for eggs. Times were not good but my father told me that his earliest and secure memories were of Russian soldiers in Shipka Pass.

After two stepfathers, Ivan came to the US with an uncle in the attar of roses business. Two years later, he was left alone in the US when he was 15 years old. By some turn of fate, he graduated from Colgate University, found my mother, and here I am, the oldest of ten children, eight of whom survive.

My mother was, as nearly as possible, a citizen of the US. Her grandfather fought in the revolutionary war, the war in which we seceded from England. Afterward, he raised a family from which I am descended, but when he was widowed, at 70 he married again and had three more children. The boy died at a normal age, but the two girls lived on and on, into my days, the last one dying in 1925. They were perhaps the last true daughters of the American Revolution.

After thinking it over, I am delighted to be descended from two such strong races, but I cannot equal my great-grandfather

Jeremiah Purdy, by having three children after 70.

My interest in computing began at an early age. My father had become an electrical engineer and in 1913, when I was 9, he moved his family to Brewster, Florida, where he was in charge of the electrical department of a phosphate mine. It was a new town, with no schools yet started. My father had a slide rule, but he felt that his position demanded a new one and it came by mail. Really, Dad did not need a slide rule; his main job was to organize the repair of motors and other equipment damaged by the strong electrical storms of Florida. So the slide rule was left for me. In two weeks, I could solve the ordinary problems of mathematics. I was delighted in a way that few other things have delighted me since that time.

The time was February. I suppose I must face the fact of your belief in the story I am telling. Yes, I suppose it is reasonable for a boy of 9 to be fiddling with a slide rule, but my memory tells me much more. I had to find out how it worked. The booklet told of logarithms. I studied logarithms, memorized their definition and use. By that time, I knew that I could not compute logarithms themselves, but that it would take some knowledge of calculus. So I studied calculus and during that summer, I calculated the logarithm of five to the base ten. My memory of this is related to the mental picture of that house and we left it soon afterward.

Two more of my memories about computers happened about the same time. My mother had an arithmetic with a chapter titled:

Numbers with Other Bases than Ten, and I studied that chapter. You will hear of this later. Also this same year I saw a calculator called a Monroe. This calculator had a profound effect on me.

The year 1913 was a very busy one in my memory but I must hurry along. In my second year of high school, I decided to be a theoretical physicist. During all of my schooling, even through college and graduate school, I was always interested in claculators and calculation.

As I foresaw years before, my graduate thesis was in Theoretical Physics. The title was: The Dielectric Constant of Helium. It was in quantum mechanics and required the solution of the Schroedinger wave equation of helium. This was a relatively hard problem in partial differential equations and gave me a start in approximating such solutions. Such problems ultimately led me to finding new computers.

I received the PhD degree in the summer of 1930 and then returned to ISC where I had been teaching mathematics. I was then the only theoretrician there, and I soon had the title Associate Professor of Mathematics and Physics. I was soon teaching graduate courses in mathematics and physics. I remembered that in my course in electrical engineering, I had not received training in electronics and so I read books on that subject, and also gave myself training in experimental work on that subject. I also spent time on all calculators that were available. During this period, I, together with Dr. A. E.

Brandt, developed a method of employing an IBM tabulator to solve complex spectra. The tabulator itself would not solve the problem, but we added certain other equipment that made the solution possible. You will understand that I am omitting much of my work, but still mention things that pertain to computing.

Soon I was teaching only graduate work and had graduate students assigned to me for direction of their thesis work. I will not give details of this work, but it will suffice to say that a number of these students were working on the approximate solution of differential equations. We had developed methods of solving such equations, but there always resulted a large system of linear algebraic equations to be solved. To obtain useful solutions required a very large number of equations. Such equations could be solved by hand, using such computers as a Monroe, but the amount of work was enormous.

I searched diligently for some practical solution of our problem. It is true that our problem was of a special type and required a special type of control, but it also required a flexibility of computing that would be necessary for a large variety of computing.

OUTLINE for BOSTON and VARNA

1. 1913. Slide rule, ordinary problems, logarithms, tables, calculus, logarithm of 5 to the base 10 (July).

2. 1913. Other points.

   Arithmetic: Numbers to other bases than ten.

   I saw and learned from a Monroe.

   I read about Valdemar Poulsen's magnetic wire.

3. About 1918 I decide on Theoretical Physics.

4. In 1921 I start at U of F in EE, no electronics.

5. PhD in 1930, study electronics, Grad Students '32 Major '33.

6. Several students interested in Raleigh-Ritz & Boussinesq.

7. We developed approx. functional methods.

8. The major difficulty is linear algebraic equations.

9. I study the availability of current calculators.

   Analog vs digital, Vannevar Bush and Sam Caldwell.

   IBM Tabulator, and other equipment.

   Monroes and Marchants etc.

   Other calculators then available.

   Nothing would do our work.

   Sadly I turn to building a new computer.

10. I start to study the structure of a useful machine.

    Analog methods are not useful.

    What media should the machine use?

    Would changing the number base help?

    Required memory, jogging, regeneration, refreshing.

    Enumeration vs logic.

11. I worked over these and other concepts for many months but I could not see a computer, nothing seeemed to jell. I remember the winter of 1937-38. What happened. Illinois.

12. Four concepts came from Illinois.

    I would use electricity and electronics for medium.

    In spite of custom I would use base 2 in my computer.

    I would use capacitors for memory but jog to avoid lapse.

    I would compute by logic, not enumeration.

  Argument over whether trip to Illinois should go to judge.

13. I study concepts for many months and perfect them, logic.

14. Late view: Every one in every computer. Outline.

15. I ask for funds and get Clifford Berry.

16. From September til November, prototype finished. Results.

17. All concepts were mental until Berry went to work.

Late in 1939 we went to work on a machine to solve large systems of linear algebraic equations. The basic concepts for this device had been formulated in my mind for some time and Berry soon grasped the idea. Later this machine was called the Atanasoff Berry Computer or the ABC.

The idea was that to solve n equations in n unknowns, we had to provide a system of n+1 banks, each substantially like the prototype computer. The extra bank is to carry the constant term of the equations. In the computer which we planned, the number of banks would be thirty so that the system was useful to solve up to 29 equations in 29 unknowns. When the computer was in operation, the coefficients and constant term of one equation was carried in the keyboard abacae of the system and likewise the coefficients and constant term of another equation was carried on the computing abacae of the sytem. Whenever the system operated to add or subtract, the numbers on the computing abacae were the coefficients and constant term of another equation that contains the same answer.

The solution of the system requires that one coefficient of the resulted equation vanish. This is accomplished by controlling ths system so that the coefficients that are to be eliminated be divided one by the other. Most advantageously, one is divided by the other by non-restoring division which I invented. From this point on we will proceed by outlining the course of items.

18. All numbers were changed from base ten to base 2. Base 2 numbers were stored on a scratch pad memory which was a base 2 card punched by electricity and read by a current of electricity.
19. The ABC could also change base 2 to base 10 numbers for the answer.
20. This device was planned to have simultaneous computing in 30 channels.